METAPHOR ACQUISITION AND USE IN INDIVIDUALS WITH NEURODEVELOPMENTAL DISORDERS

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1. INTRODUCTION

As previous chapters in this volume have already demonstrated, metaphor is an inherent part of human life, not just in terms of how we communicate with others, but also in how we perceive and learn about the world and people around us. Utilisation of metaphors in educational contexts is well established (Cameron, 2003), and is in no way limited to language learning and literacy. In fact, it is almost impossible to learn about science without the use of metaphors (Jakobson & Wickman, 2007; Niebert, Marsch, & Treagust, 2012; see also Chapter 25). Metaphor is also crucial in establishing, expressing and negotiating our own identity with others (see Chapter 32). In everyday life, metaphor is seldom a one-way communication tool, rather it is essential that both speaker and hearer utilise metaphor in a similar fashion. But what happens if a person cannot or struggle to learn to understand and appropriately use metaphors?

This chapter will discuss to what extent individuals with neurodevelopmental disorders, such as Autism Spectrum Disorder, find metaphor acquisition difficult. By studying metaphor in atypically developing individuals, we can better grasp what most likely underpins normal metaphor acquisition and use, and by contrasting disorders, we can attain insight into how difficulties with metaphors can (potentially) be overcome. We will also address which types of metaphors have been investigated and how these types relate to cognitive linguistic theory. Although there are numerous neurodevelopmental disorders, metaphor studies have to date been limited to five disorders: Specific Language Impairment (SLI), Autism Spectrum Disorder (ASD), Down's syndrome (DS), Williams syndrome (WS), and Schizophrenia.[1] Before outlining how the term *metaphor* has been applied in studies of atypical language development and what these studies have found, we first need to briefly introduce the neurodevelopmental disorders that this chapter will focus on.

Neurodevelopmental disorders

The development of the human brain and nervous system starts already in the early prenatal stage. When this growth is impaired, we can often discern an impact on the child's behaviour, emotion, memory, intelligence, and/or language. The causes of neurodevelopmental disorders are typically genetic. New genetic disorders are continuously discovered, but whether these disorders include abnormal language development remains to be established. At the same time, well-researched, genetically complex, language disorders such as SLI and ASD are still under active investigation (Carter & Scherer, 2013; Simpson et al., 2015). In the case of SLI, data from behavioural studies targeting language performance are well established, while investigations into the cause and origin of the disorder remain (at least in part) inconclusive. For ASD, we find a great need for more detailed subtyping according to language (Rice, Warren, & Betz, 2005).

Specific Language Impairment (SLI)

SLI is the standard diagnosis applied to children who report with (moderate to severe) atypical language development in the absence of another diagnosis. In other words, the language impairment cannot be ascribed to a physical handicap, environmental deprivation or a lower than average cognitive ability (*Diagnostic and statistical manual of mental disorders* (DSM-5), 2013). The exact definition of this disorder has been debated for decades (Bishop, 1997). In practice, this means that some children who are later diagnosed with another neurodevelopmental disorder might have first been given the diagnosis of SLI. Although SLI is commonly thought of as a language-only disorder, studies have shown co-morbidity with poor motor skills (Hill, 2001; Richtsmeier & Goffman, in press), poor auditory perception (Bishop & McArthur, 2004), and most recently a correlation between linguistic and cognitive ability (Liao et al., 2015).

Autism Spectrum Disorder (ASD)

Individuals with ASD are commonly divided into three main subgroups: Asperger syndrome, high functioning ASD, and low functioning ASD. However in DSM-5, Asperger's was eliminated and collapsed under ASD (Kent et al., 2013). In contrast to individuals with low functioning ASD, some of whom use five or fewer words per day,[2] individuals with high functioning ASD present with 'relatively and selectively preserved language and cognitive abilities' (Felder, McPartland, Klin, & Volkmar, 2014, p. 1). Some studies prefer to distinguish between ASD with normal language and with language impairment. Similar to the distinction between high functioning and low functioning ASD, ASD individuals with normal language and with language impairment typically differ significantly on tests measuring verbal IQ and non-verbal IQ. Nevertheless, characteristics common for both groups (regardless of label) include difficulties with social communication, social interaction, and social imagination – all of which are often paired with challenging behaviour.

Down's syndrome (DS)

DS is caused by a partial or full trisomy of chromosome 21, which can often be identified prenatally by a nuchal translucency scan, alternatively through an amniocentesis test. Individuals with DS have distinct facial appearances, but also suffer from heart conditions among other physical conditions. They typically present with non-verbal IQ ranging from 35 to 70 (Chapman & Hesketh, 2000). Children with DS are delayed in their language development. However, it is important to note that it is predominantly syntax acquisition that is affected, thus they 'show an incongruence between nonverbal cognition and grammatical development but a congruence between vocabulary and nonverbal cognitive skills' (Rice et al., 2005, p. 20).

Williams syndrome (WS)

WS is a rare genetic disorder that is caused by a micro-deletion on the long arm of chromosome 7q11.23. Individuals with WS are recognisable by their dysmorphic facial characteristics, hoarse voice, and overfriendly behaviour, and in addition they tend to suffer from a range of health conditions (e.g. kidney problems and joint abnormalities). WS is also associated with impaired cognitive ability, with non-verbal IQ ranging between 40 and 100 (Pober, 2010). Similarly to DS, children with WS show strength in their vocabulary acquisition, but struggle with grammar.

Schizophrenia

Unlike the previous four disorders, which without a doubt are neurodevelopmental in origin, Schizophrenia displays a much greater variability in age of onset,[3] as well as a greater number of candidate genes. This heterogeneity has called into question whether Schizophrenia is a neurodevelopmental disorder or a degenerative brain process (Gross & Huber, 2008). It has recently been argued that its 'illness-related cognitive impairment is neurodevelopmental in origin and characterized by slower gain (developmental lag) but not cognitive decline' and that 'the severity of underlying neurodevelopmental abnormality determines the age that cognitive deficits first become apparent' (Bora, 2015, p. 1). Although Schizophrenia is typically classified after psychosis sets in, the declining cognitive profile of those who will go on to be diagnosed with Schizophrenia has been said to be striking enough that individuals could be identified (and potentially treated) much earlier (Kahn & Keefe, 2013).

These five neurodevelopmental disorders overlap to various degrees in several respects. Similar to Schizophrenia, some individuals with ASD experience paranoid ideations (Jänsch & Hare, 2014; Unenge Hallerbäck, Lugnegård, & Gillberg, 2012). DS, WS and low functioning ASD share a below average cognitive ability, but only DS and WS feature distinct physiology. Although SLI is defined as language impairment without cognitive impairment and high functioning ASD (or ASD with normal language) is thought of as normal language ability without cognitive impairment, the social communication impairment of ASD can generate a linguistic representation almost indistinguishable to that of a child with SLI. In other words, clinical linguists and educational psychologists are often faced with the task of dissecting whether a child's language is abnormal due to a neurodevelopmental language impairment or is the by-product of 'awkward' language in an overwhelming social situation that is often further impaired by inappropriate behaviour.

We will return to the five disorders in Section 2, but first we will briefly outline a few points about methodology and terminology, since, as shall become apparent, many of the inconsistent results in this field stem from the methodological approach and terminology applied.

Methodology, terminology and critical issues

Studies of developmental disorders have commonly compared performance (e.g. on a language task) in a disorder group with both a typically developing (TD) group matched for chronological age, and a second TD group matched on mental age, where mental age can be linked to verbal ability or non-verbal ability. In matching approaches, significant differences in performance between the disorder group and both control groups are interpreted as impairment. An absence of difference between the disorder group and the mental age control group (i.e. both these groups differ significantly from the chronological age control group), on the other hand, is indicative of delay rather than impairment. More recent approaches, such as developmental trajectories or growth models employ a wide age range[4] to be able to gauge performance development (Thomas et al., 2009). Statistical analysis using a linear regression model plots performance against chronological age as well as mental age. Developmental trajectories allow comparison between groups for onset and rate of development, which in turn enables clear discrimination between delay due to late onset, delay due to slow rate of development and impairment.[5] Both approaches have been utilised in studies of metaphor in neurodevelopmental disorders.

One of the primary issues in psycholinguistic and clinical linguistic studies of figurative language is the lack of consensus around the term *metaphor*. At best, the term is applied in accordance with the definitions outlined in earlier chapters of this volume. Thus, we find that some studies have targeted clearly defined types of metaphors; for example, sensory metaphors (Van Herwegen, Dimitriou, & Rundblad, 2013) and primary metaphors (Olofson et al., 2014; Özçalişkan, 2005). But at the opposite end, we find studies of so-called 'child metaphors', which have been extensively questioned (Gentner, 1988). In one of his early papers, Kanner (1946, p. 242) described instances where a child with ASD would use 'metaphorical language' or 'irrelevant phrases', such as 'Peter eater' for saucepans because the child's mother had once said 'Peter, Peter, pumpkin eater' while dropping a saucepan. There is, thus, also a tendency to overextend *metaphor* for other linguistic devices. In addition, we find metaphors grouped under umbrella terms such as *pragmatics, inference*, *analogy, figure of speech, figurative language, lexical ambiguity* and *polysemy*, usually together with other devices that are not metaphors (e.g. idioms, irony, similes, metonymy, hyperbole and litotes) (Rundblad & Annaz, 2010a). In this chapter, we will exclusively look at studies where the test materials included metaphors, notably linguistic realisations of conventional conceptual metaphors (e.g. exploding for 'very angry'), sensory metaphors (e.g. smooth for 'charming') and perceptual metaphors (e.g. flying for 'running fast').

In the context of neurodevelopmental disorders involving language, it is imperative that we investigate the full-time course of an individual's language development. This means that we need to include age as an independent variable, in some way; preferably by means of longitudinal studies. We need to be able to distinguish whether the individuals' atypical language is delayed or potentially irrevocably impaired. Further, to get a clear picture of what areas of language are affected and in what way, it is essential that clear and delineated terminology, based on current linguistic theory, is employed. The relation between language and cognition can be very complex. Each type of figurative language has most likely its own course of development, and it has also been argued that some types of figurative language function as a stepping stone or scaffold for more complex types (Rundblad & Annaz, 2010a). Theory specific and age sensitive studies are crucial.

In the next section, we will look at the extent to which the different types of metaphors identified and described in cognitive linguistic theory have been investigated in atypical language populations. To this end, we will briefly review studies of metaphor comprehension, processing and production for each of the five disorders outlined above.

2. ACQUISITION AND USE

There are three main components to the study of acquisition and use of metaphors: comprehension, production, and processing. Studies focusing on the acquisition of metaphor commonly look at either comprehension or production. Production also overlaps with processing, in its focus on metaphor use. However, the greatest overlap is between processing and comprehension. An important feature of processing studies is the need to test novel metaphors as opposed to lexicalised ones. When participants are tested on lexicalised metaphors, they retrieve the meaning directly from the mental lexicon. In child language studies, it can at times be impossible to ensure that a lexicalised metaphor is not unfamiliar, and thus novel, to individual children. Novel metaphors, on the other hand, require the language user to create meaning, and it is that process of creation that processing studies target. Each of these three areas tend to be associated with specific research techniques; brain scans are nowadays increasingly utilised in processing studies, while stories form a significant part of many comprehension studies.

There are sadly only a few metaphor studies in DS, and some of these are actually studies where DS participants function as a control group, rather than being the focus of the study. It is possible that this shortcoming is at least partially due to the general assumption that language in DS is 'merely' delayed. In short, we should expect to find the same patterns, whether for comprehension, processing or production, in DS as for TDs, except that onset is later and possibly the rate of development is slower (Tager-Flusberg et al., 1990).

Comprehension

In comprehension tasks, participants need to communicate what they understand the target metaphor to mean, unlike processing studies where they typically select 'yes' or 'no' to signal whether a test sentence is meaningful or not. This can be achieved by the participant selecting an option, which could be a picture, synonym or definition. Comprehension tasks where the participant is required to verbalise their understanding can, on the other hand, affect performance in disorder groups and very young TD children negatively; yet, data from such tasks can be very informative and should not be discouraged.

One thing that can complicate metaphor comprehension is difference in executive function. Executive function includes 'a variety of higher order strategic/organizational cognitive functions including inhibition, working memory, attentional flexibility and planning' (Rhodes, Riby, Park, Fraser, & Campbell, 2010, p. 1217). Both DS and WS are associated with impaired executive function (Rhodes et al., 2010; Rowe, Lavender, & Turk, 2006). In a rare DS case study, an adult Italian woman was required to verbally explain what each target metaphor means (Papagno & Vallar, 2001). The study concluded that metaphor comprehension was impaired, and suggested that the poor performance could be linked to the participant's impaired visuo-spatial ability and executive function. Similarly, 11 WS individuals were required to explain the meaning of two statements in a story: one metaphoric and one sarcastic (Karmiloff-Smith, Klima, Bellugi, Grant, & Baron-Cohen, 1995). The authors found a very strong positive correlation between metaphor and sarcasm ability. Importantly, only half of the participants succeeded on the task. More recently, comprehension on lexicalised metaphor was tested in 30 WS individuals between the age of 7;01[6] and 39;10 years old (Rundblad, Dimitriou, & Van Herwegen, in press). The task utilised pictures in order to reduce executive function demand. Using a developmental trajectories approach, the study found that onset of metaphor comprehension in the WS population is around 6 years old and comprehension does improve with chronological age as well as verbal ability – a result which is attributed to the fact that the test sample included middle aged WS adults. In order to determine whether performance truly is delayed or impaired, it is necessary to test a much larger age range than what is normal in TD language studies.

Results from an early study with children with SLI suggested that metaphor comprehension in this disorder is intact (Vance & Wells, 1994). The test materials included idioms, dead metaphors as well as perceptual metaphors, and a forced choice out of three pictures was used to indicate comprehension. In forced-choice designs, participants must indicate their understanding by selecting one answer from three (or more) options provided, which are usually in picture format. Generally, these depict the intended metaphorical meaning, a possible but less likely literal meaning, and one or more distractors. However, the TD children were matched on verbal ability rather than chronological age, and were thus significantly younger (6;4-7;8 years old) than the SLI children (7;10 – 13;1 years old). Contrasting verbal and visual metaphor comprehension, Highnam and colleagues (1999, p. 27) tested 12 children who were 'language disordered' but with a performance IQ score above 80 on WISC-R and 12 age-matched TD controls. The study used the Metaphoric Triads Task (Kogan, Connor, Gross, & Fava, 1980), which includes sensory metaphors, perceptual metaphors and conceptual metaphors (Kogan & Chadrow, 1986).[7] Results showed better comprehension in the TD group for both visual and verbal metaphors, and both groups performed better on visual metaphors. Highnam and colleagues (1999, p. 30) suggest that 'the iconicity of metaphors in visual form renders them less abstract than the more highly arbitrary medium of verbal coding', but also that visual metaphor tasks are mediated by language and thus are affected to a greater degree in individuals with language impairments. There are no recent studies that specifically target metaphor comprehension in SLI (but see discussion of sentence completion tasks in the metaphor production section below).

There are numerous metaphor comprehension studies in ASD, most of which have looked at children and adolescents with high functioning ASD or Asperger's. Two studies using the same metaphor comprehension task, one with high functioning ASD children (Dennis, Lazenby, & Lockyer, 2001) and one with high functioning ASD adolescents (Minshew, Goldstein, & Siegel, 1995), found significantly worse performance compared to TD controls matched on chronological age and non-verbal ability. One of the reasons put forth as underlying the impaired performance, but which was not tested for, was a lower ability to detect the intentionality behind the metaphorical utterance (Dennis et al., 2001). More recently, a small sample of ASD children (age range 5;4-11;4) were compared to age-matched TD controls on comprehension of lexicalised metaphors incorporated into short stories, where participants were required to express their understanding (Rundblad & Annaz, 2010b). Onset of comprehension in the ASD children was found to be around age 7.5 years. Using developmental trajectories, the study found that metaphor comprehension was severely impaired in the ASD group as it did not improve reliably with chronological age, nor with increasing verbal ability. The authors also looked at the effect of Theory of Mind (ToM) on comprehension (Baron-Cohen, 2001; Baron-Cohen, Leslie, & Frith, 1985). ToM refers to the ability to mind read or infer other people's feelings, intentions and thoughts. A crucial distinction is made between first-order ToM (i.e. 'I think person X thinks Y') and second-order ToM (i.e. 'I think person X thinks person Y thinks Z'), where second-order ToM is more complex and therefore typically develops later than first-order ToM. Although, the authors had presumed a correlation between first-order ToM abilities based on results for metaphor production in this population (Happé, 1993), no such link could be found.

In a study of pragmatic comprehension in 25 adults with Schizophrenia, metaphor comprehension was measured using a computerised story task where participants were required to select 'yes' or 'no' to indicate whether an utterance made sense (Langdon, Coltheart, Ward, & Catts, 2002). Results showed impaired metaphor understanding as well as poor first-order ToM abilities and executive function deficits; however, no causal link between first-order ToM and metaphor comprehension could be established, unlike irony comprehension which did show an association with first-order ToM. In contrast, Mo and colleagues (2008) did find a correlation between metaphor comprehension and second-order ToM abilities, while irony showed no correlation, when testing 29 participants with Schizophrenia. These results are interesting and potentially conflicting, given the common assumption that irony is harder to comprehend than metaphor, and thus should require second-order ToM abilities (Happé, 1993).

Recent years have seen metaphor comprehension studies extend towards novel metaphors, testing whether lexicalised metaphors are understood earlier and better. Thus, Hebrew-speaking children with ASD tested on visual metaphors (i.e. the Metaphoric Triads Task), lexicalised metaphors and novel metaphors, proved to perform better on visual metaphors, though they performed worse on all metaphor tasks compared to age-matched TDs (Mashal & Kasirer, 2012). Interestingly, the study also found a relative weakness in suppressing irrelevant contextual information in the ASD group, but no difference between novel and lexicalised metaphors.

An investigation using a forced-choice picture design of 34 children and adults with WS tested performance on novel sensory metaphors (e.g. <u>marshmallow</u> meaning 'a soft pillow') and non-sensory metaphors (e.g. <u>turtle</u> referring to 'a slow car') (Van Herwegen et al., 2013). The study found that onset of novel metaphor comprehension is around the age of 8 in WS and comprehension did not improve with chronological age or with verbal ability; instead a significant impairment, compared to age-matched TDs controls, was established. Although the stories and pictures were specifically designed to be suited to WS participants with poor working memory, it is still possible that poor comprehension was due to impaired executive function, which was not included in analysis.

Olofson and colleagues tested comprehension of novel and lexicalised primary conceptual metaphors in children and adolescents with ASD (age range 7;03-22;03) and age-matched TD controls (Olofson et al., 2014). The ASD group was partly recruited from a mainstream school and partly from a private ASD centre, which could indicate a division between high functioning and low functioning ASD. Conceptual Metaphor Theory (CMT) (Lakoff & Johnson, 1980) and Grady's theory of primary conceptual metaphors (Grady, 1999) hold that primary metaphors are acquired through embodied experiences very early in childhood. Thus, we should expect no improvement in performance with increasing chronological age and no difference in performance due to lexicalisation. The study found that ASD participants understood novel and lexicalised primary metaphors equally well, albeit not as well as the TD controls. Further, it was found that chronological age did not impact performance at all, but that verbal ability was a marginally significant predictor for novel metaphor comprehension for both ASDs and TDs. There was also an indication of better performance on lexicalised metaphors in the mainstream ASD group, but with a sample size of 13, replication is necessary before firm conclusions can be drawn.

Processing

Online processing tasks typically involve error rates, reaction time or eye tracking measures. Reaction time studies commonly combine with some form of neurological technique, such as fMRI, ERP and TMS[8]. Studies of metaphor processing have thus far been limited to Schizophrenia and ASD (to date, ASD studies have predominantly been limited to Asperger's).

A key focus in metaphor processing has been on lexicalised versus novel metaphors, often under the auspices of Giora's (1997) Graded Salience Hypothesis (GSH). Although, GSH originated in the context of idioms, it has been extended to metaphors. GSH argues that whether a word is used in its literal or figurative meaning is far less relevant than whether that word and its intended meaning is familiar/lexicalised and salient in the context that it occurs in. Therefore, GSH predicts that performance on lexicalised metaphors will be better than on novel ones. Based on two experiments in Hebrew measuring error rates and reaction time with young adult TD controls and young adults with Asperger's, Giora and colleagues (2012) found consistent evidence that both test groups performed better on familiar metaphors. While controls did not struggle to process novel metaphor, the Asperger's participants needed a supportive (i.e. salient) context to be able to judge them as meaningful.

Like neurological TD studies, neurodevelopmental disorder studies have also sought to address whether metaphor resolution is linked to a right hemisphere or a left hemisphere superiority. An fMRI study on German adults with Schizophrenia tracked the signal changes caused by novel metaphor processing to the left inferior frontal gyrus (BA 45) alone (Kircher, Leube, Erb, Grodd, & Rapp, 2007), while healthy individuals displayed signal changes in the left lateral inferior frontal gyrus (BA 45/47) and the right superior/middle temporal gyrus (BA 39) (Rapp, Leube, Erb, Grodd, & Kircher, 2004). In parallel Hebrew study, Mashal and colleagues (2013) tested both lexicalised and novel metaphors. The healthy controls displayed the same pattern for novel metaphors as the previous study, namely that both hemispheres are recruited. The clinical group, on the other hand, exhibited a failure to recruit the right hemisphere and a consequent compensatory recruitment of the left middle frontal gyrus (BA 46) and the left precuneus (BA 7). In a study featuring Asperger's individuals and TD controls, a visual field paradigm[9] was used that required participants to make semantic judgements about word pairs, including perceptual lexicalised and novel metaphors (Gold & Faust, 2010). As for Schizophrenia, the right hemisphere contributed less to novel metaphor processing in the Asperger's participants, negatively affecting their performance. Right hemisphere processing is specific for novel metaphors only (Bohrn, Altmann, & Jacobs, 2012), in line with GSH.

ERP studies of semantic processing in Schizophrenia have generally found greater N400 amplitudes. N400 is a downward spike detectable around 400 milliseconds after the stimulus is presented and is typical when processing words and meanings. The greater N400 amplitudes mean the semantic processing 'cost' in Schizophrenia is generally greater than in the general population. In a French study of individuals with Schizophrenia versus healthy controls, participants were tested on 160 highly lexicalised metaphor (Iakimova, Passerieux, Laurent, & Hardy-Bayle, 2005). Results showed longer reaction time latencies and greater N400 amplitudes for the clinical group. However, greater amplitudes were found for all test conditions. Thus, the study concluded that there was no evidence of a specific metaphor processing deficit, but instead individuals with Schizophrenia display a general reduced efficiency in integrating and making sense of the semantic context.

Gold and colleagues (2010) tested 17 adults with Asperger's and 16 controls (all Hebrew speakers) on 60 lexicalised metaphors and 60 novel metaphors elicited from poetry. The Asperger's group elicited greater N400 amplitudes for metaphors, with differences between lexicalised and novel stimuli being clearly discernible. Thus, a similar inability to integrate semantic information is found for Asperger's, as we saw for Schizophrenia. In a follow-up paper, Gold and Faust put forth the argument that individuals with Asperger's experience difficulties with novel metaphors because these 'violate semantic rules, in a non-systemized manner' (2012, p. 67). It is, thus, the well-established ToM inabilities in ASD that underlie their poor performance.

Production

There are significantly fewer production studies compared to comprehension and processing, most likely due to many neurodevelopmental disorders affecting speech and fluency, making production studies more challenging. We can discern two types of production designs: a) the participant produces coherent speech which can vary in length from a short sentence to a story or retelling, and b) the participant responds verbally with an answer, which usually is less than a sentence long, but which crucially includes the sought metaphor. It should be noted that some studies prefer to classify sentence completion tasks as comprehension tasks rather than production tasks.

Comparing performance between individuals with ASD with a control group of individuals with moderate learning difficulties (matched on verbal ability), Happé (1993) utilised a sentence completion task where participants were required to select a simile, metaphor, or a synonym from a list of target words that also included one distractor item. Although the author does not discuss metaphor types tested, the targets listed suggest that they were lexicalised perceptual metaphors (e.g. 'The dancer…was a swan'). Heavily influenced by Relevance Theory (Sperber & Wilson, 1995; see Chapter 4), Happé opted to sub-divide the ASD group by performance on a battery of ToM tasks. The battery consisted of first-order and second-order ToM tasks, and ASD participants were divided into three groups: failed both types of tasks, passed only first-order tasks, and passed both types of tasks. Both individuals with ASD and with moderate learning difficulties performed equally well on synonyms and similes, but for the metaphor condition, the ASD participants who had failed both ToM tasks performed significantly worse. The use of a verbal ability matched control group suggests that the difference in performance is not due to general verbal ability, instead Happé suggested the main contributor to metaphor ability is ToM ability. However, this study did not control for age (i.e. there was a wide age range (10–28 years old)) and there was no TD control group.

Happé's study was replicated by Norbury (2005), who included a TD group (matched on chronological age and non-verbal ability) as well as additional background measures for verbal ability. The age range in Norbury's study was 8-15 years old. Unlike Happé's study, this study included several disorder groups: SLI, Pragmatic Language Impairment, and Asperger's/high functioning ASD/ASD. In contrast to Happé's results, Norbury found that verbal ability contributed significantly more than ToM ability to metaphor performance. However, one of the verbal ability tasks actually contained metaphors, which could explain the discrepancy compared to Happé's results for ToM abilty. Nevertheless, these two studies show a clear impairment in metaphor production in ASD and quite likely in SLI as well, as the disorder groups were combined in Norbury's analysis.

Neither Norbury nor Happé sought to determine when metaphor production first starts to develop in ASD and SLI, but Norbury's results showed that performance improves with age. A recent study testing Hebrew speaking adults with high functioning ASD and TD controls found that the high functioning ASD group was not only more prolific at producing metaphors for common emotions, but they also created more novel metaphors (Kasirer & Mashal, 2014). This study used a sentence completion task, and participants were particularly encouraged to be creative. It might seem as if this result is at odds when compared to the previous studies. However, metaphor as a tool to describe one's disorder and perception of self is well documented in the adult ASD community (Blackman, 2014; Williams, 1998). In fact, Williams sees life with ASD as living a metaphor. Blackman, who is non-verbal and communicates by typing, describes herself as wordless, with language inside her, but when she writes poetry she needs to stand outside herself to look at who she is. It seems that a pronounced focus on self is typical for poets with ASD (Roth, 2008). Many of the metaphors used by individuals with ASD are sensory in nature; they are generally understandable, yet strikingly different. These novel sensory metaphors could perhaps be explained by Baron-Cohen and colleagues' (2013, p. 40) finding that synaesthesia, which is 'a neurodevelopmental condition in which a sensation in one modality triggers a perception in a second modality', is three times as common in adults with ASD than in TDs. This study included predominantly individuals with high functioning ASD/Asperger's. If indeed the metaphors generated in Kasirer and Mashal's study are due to their participants being synaesthets, it is debatable whether we should treat them as metaphors at all.

Using a wordless picture book that participants needed to tell a story about, Naylor and Van Herwegen (2012) looked at production of metaphors along with several other figurative language devices in individuals with WS (age range: 7-18 years) and age-matched TD controls. Unfortunately for our purpose, the different figurative language devices were not separated in the analysis, nor were types of metaphors distinguished. The study found no reliable developmental trajectory for either group when plotting results against chronological age. The authors concluded therefore that since there was also no significant difference in frequency of metaphors produced, there is no delay or impairment in metaphor production in WS. However, closer scrutiny of the study show that performance improved significantly with better non-verbal ability and verbal ability[10] in the WS group alone. This difference between the two groups could be indicative of a delay in early metaphor production in the WS group that had disappeared by the time they participated in the study.

Schizophrenia is associated with increasingly atypical language, especially in areas such as semantics and pragmatics (Salavera, Puyuelo, Antonanzas, & Teruel, 2013), with similarities often being drawn with the language of ASD. The earliest studies of metaphor production in Schizophrenia did not distinguish metaphor from similes, but interestingly found frequent use of figurative language (Billow, Rossman, Lewis, Goldman, & Raps, 1997). In a recent study, Dutch speaking adults diagnosed with Schizophrenia (all with average non-verbal IQ) and age-matched controls were asked to describe an emotional event in their personal life (Elvevåg, Helsen, De Hert, Sweers, & Storms, 2011). Coding for 'spontaneous metaphors' (which we equate with linguistic realisations of 'conceptual metaphors'), surprisingly few metaphors were found and there was no statistically significant difference in production between the Schizophrenia group and the control group. The authors suggest that this low incidence could be due to anhedonia in the clinical group, which was not measured; however, that would not explain the comparatively low rate in the control group.

Short summary

As this section has shown, studies of metaphor acquisition and use have made great progress investigating neurodevelopmental disorders, though less so in DS and SLI. Consistently, individuals with SLI, ASD, DS, WS, and Schizophrenia perform below TD/healthy controls, with child studies suggesting a delayed onset of metaphor acquisition or slower rate of development of metaphor abilities. In the case of WS, DS and SLI, there is some indication that performance will improve with time, while ASD and Schizophrenia show severe impairment that persists into (early) adulthood, especially with regards to novel metaphors. The next section will discuss how these results tie in with theories and models, and whether there is scope and reason for intervention.

3. IMPLICATIONS FOR THEORY AND INTERVENTION

There is generally a strong focus in neurodevelopmental studies on theoretical accounts that seek to explain why non-neurotypical individuals differ in their performance compared to controls. The three main theories, which are not at all metaphor or language specific, are ToM, executive function, and weak central coherence (WCC). There is some overlap between WCC and GSH in their emphasis on salience and context, but unlike WCC, GSH is specific to figurative language.

Although it seems clear that executive function easily impacts performance in various disorders, especially those associated with below average non-verbal ability (i.e. WS and DS), the role it plays in metaphor acquisition and use is more to do with its effect on language overall. In particular, intact executive function is needed to process the sentences and stories that make up the test materials. Therefore, executive dysfunction is only a partial explanation, and should preferably be controlled for experimentally.

This chapter has outlined great variability in results with regard to ToM. Some studies have found very clear links between metaphor performance and first-order ToM, while others found no correlations at all. ToM can, like WCC, be tested in a great many ways and it is possible that the choice of ToM task contributes to whether a relation is found or not. However, there is increasing suggestion that while ToM and metaphor acquisition and use are impaired in many individuals with one of our five disorders, ToM need not be a prerequisite to using and understanding some or all aspects of metaphoric language (Tendahl & Gibbs Jr, 2008). Importantly, there is evidence suggesting that the development of language skills precedes the development of ToM, thus reducing the likelihood of causal link (Hale & Tager Flusberg, 2003). The question we ask is whether ToM is needed for some metaphors.

GSH stresses the importance of context for metaphor resolution; however, context reliance is abated in the case of familiar (i.e. lexicalised) metaphors. There is compelling evidence that novel metaphors are harder to comprehend and process, and that they are more reliant on salience. The conspicuously more demanding nature of novel metaphors is also visible in hemisphere/hemifield studies that show a clear connection between metaphor failure and failure to sufficiently activate the right hemisphere. Putting all the evidence in favour of GSH aside, we also need to address instances where the predicted difference between lexicalised and novel metaphors fails to realise.

Cognitive linguistics assumes that early metaphor development is grounded in embodied experience (Gibbs, Lima, & Francozo, 2004). Studies that have tested young children on primary metaphors have found that once acquired, performance on novel primary metaphors are as good as for lexicalised metaphors. This raises the issue as to what types of metaphors have been tested. Generally, mixed types of metaphors have been selected, and very few disorder studies have exclusively focused on conceptual metaphors, preferring more traditional types such as perceptual metaphors. It is very likely that the conflicting results in the studies discussed in this chapter are the product of non-conceptual metaphors actually relying on ToM and salience, while conceptual and primary metaphors do not.

Turning to the question of practical applications, we quickly note that there are few intervention studies, yet ASD authors such as Williams and Blackman describe how they have ‘retrained’ their thinking, suggesting intervention as a viable and desirable avenue. Mashal and Kasirer (2011) specifically focussed on novel metaphors. They used ‘thinking maps’ to teach ASD children the semantic relations between words that the children might not even have noticed are related. The outcome of the study showed an improvement in novel metaphor comprehension, as well as a correlation with semantic knowledge.

It is clear that further studies of metaphor acquisition and use are greatly needed, and in addition to cross-sectional studies, we need longitudinal studies with and without interventions. These needs are addressed in the next section.

4. FUTURE DIRECTIONS

The most apparent and acute need is that we devise more systematic ways of testing metaphors that highlight the patterns that different sub-types of metaphor may give rise to. Even primary metaphors, which for a long time seem to have been one homogeneous group, are susceptible to differences between subgroups (Siqueira & Gibbs, 2007), and TD results for complex conceptual metaphors (Lachaud, 2013) need to be replicated and extended to atypical populations. Further, a wider range of potential underlying abilities need to consistently be tested for, to determine the extent to which they can predict metaphor performance. Thereafter, theory driven intervention studies should be designed to address whether targeting established underlying abilities (e.g. sense relations or ToM) can improve performance of different types of metaphors, or whether utilising the differences and links between metaphorical sub-types or other figurative language devices (e.g. metonymy) could have an even greater impact.

Delayed or impaired metaphor acquisition is not specific to neurodevelopmental disorders, e.g. individuals with unilateral cochlear implants struggle with metaphors despite normal discourse inference comprehension (Nicastri et al., 2014). We thus need to extend the atypical populations we study in order to get a more comprehensive overview of performance, underlying factors and obstacles. In addition, language investigations of siblings to individuals with neurodevelopmental disorders (Jones & Conti-Ramsden, 1997; Yirmiya et al., 2006) forces the question as to how wide the disorder spectrum might be and where the ‘true’ boundaries for abnormal language may lie.

Finally, one of the ‘default’ problems with any area of psycholinguistic research is the relative abundance of studies on English. A related issue is publication language; for example, there is increasing research in Korean on executive function and metaphor comprehension in SLI (Hong & Yim, 2014) and metaphor/simile production in Attention Deficit Hyperactivity Disorder (Lim, 2010), but these publications are only available in Korean. Access to published studies should whenever possible, include translation options.

NOTES

[1] A substantial number of people have one of these five neurodevelopmental disorders. In the UK, the combined prevalence rate is estimated to approximately 9%, with SLI contributing 7% and ASD 1% of that figure (Baird et al., 2006; Nation, 2008).
[2] Approximately 20 percent of children with ASD are nonverbal (Rice et al., 2005).
[3] Earliest age of onset is 13 years.
[4] In matching approaches, it is essential that the age range within the disorder and TD groups is comparatively narrow. Matching studies can of course include age as an additional, well-defined independent ordinal variable (i.e. the study would include two or more age samples per group).
[5] While it is very hard to imagine some form of 'catching up' for the last two, it is possible that a child with delayed onset carries on developing when typical peers have reached mature performance.
[6] 7;01 stands for 7 years and 1 month.
[7] Note that Kogan and colleagues label the first two types of metaphors *physiognomic* and *configural*.
[8] While structural MRI can detect brain size differences (e.g. ASD is associated with overall larger brain areas, except for the corpus callosum which is smaller (Stanfield et al., 2008)), fMRI (i.e. functional magnetic resonance imaging), ERPs (i.e. event-related (brain) potentials) and TMS (i.e. transcranial magnetic stimulation) can determine areas of brain activation (Friederici, Pfeifer, & Hahne, 1993; Gabrieli et al., 1996; George, Wassermann, & Post, 1995). Note that although TMS has been used in both ASD and Schizophrenia, metaphor studies using TMS are still lacking in disorder populations. Similarly, fMRI studies in ASD have targeted irony.
[9] This experimental technique presents visual stimuli either on the left (causing signals go to the right hemisphere) or the right (transmitted to the left hemisphere) visual field. If the participant performs better on items displayed on the left, the conclusion that the right hemisphere has a functional advantage can be drawn, and vice versa for right field presentations.
[10] Notably, synonym ability yielded the strongest trajectory.

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